

REMARKS

Claims 1-13 remain in the application with Claim 1 being independent. By the present amendment claims 1 and 4-13 have been amended.

The Examiner had objected to Claims 5-13 under 37 C.F.R. § 1.75(c) as being in improper form because a multiple dependent claim cannot depend from another multiple dependent claim, M.P.E.P. § 608.01(n). By the present amendment, Claims 5-13 have been amended from multiply dependent claims to dependent claims, thus this objection is overcome.

The Examiner rejected Claims 1-4 under 35 U.S.C. § 112, second paragraph, as being indefinite. Specifically, the Examiner pointed to step (ii) of Claim 1 and the language “if desired”. Claim 1 has been amended to replace the phrase “if desired” with the phrase “optionally”, thus this rejection is believed to be overcome. The Examiner rejected Claim 4 under 35 U.S.C. § 112, second paragraph, as being indefinite for use of the phrase “selected from among” as being improper Markush terminology. Claims 4 and 5 have been amended to remove this language and replace it with the phrase “comprises”. Thus, this rejection is believed to be overcome.

The Examiner rejected Claims 1, 2, and 4 under 35 U.S.C. § 112(b) as anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as obvious over *Bauriedel* (709). The Examiner states that the patentee discloses a method for producing polyurethane prepolymers, wherein the method encompasses reacting a diisocyanate having isocyanate groups with differing reactivities with a polyol, including triols, to yield a product which is then reacted with another diisocyanate. The patentee further discloses preferred ratios of initial hydroxyl groups to initial

isocyanate groups which in the Examiner's opinion will yield Applicants' claimed addition product (A).

The present invention is directed toward a process for preparing high-functionality polyisocyanates in a controlled and defined fashion rather than prior art systems of random addition. In the first step of this process as claimed in Claim 1, an addition product (A) is produced which contains an average of only one group which is reactive toward isocyanate and at least two free isocyanate groups. The product (A) is produced by reacting a first diisocyanate or a first polyisocyanate with either compounds having at least three groups which are reactive toward isocyanate or compounds containing two groups which are reactive toward isocyanate, or mixtures of these compounds. An optional second step is an intermolecular addition reaction of product (A) to form a polyaddition product (P) which contains an average of only one group which is reactive toward isocyanate and an average of more than two free isocyanate groups. As a final step, the addition product (A) and/or the polyaddition product (P) is reacted with a second diisocyanate or a second polyisocyanate. Key toward controlled development of highly functional polyisocyanate per the present invention is preparation of an addition product (A) containing only a single group which is reactive toward isocyanates and at least two free isocyanate groups. The Examiner is directed to Page 6, Lines 29-35, wherein this is revealed in the present specification. In addition, the Examiner is directed toward the examples of the present specification which all disclose production of an addition product (A) wherein the addition product contains an average of one isocyanate reactive group and at least two free isocyanate groups.

By way of contrast, *Buriedel* is directed to formation of polyurethane prepolymers wherein a polyhydric alcohol is initially reacted with an asymmetric diisocyanate at high hydroxyl to isocyanate ratios such that only the faster reacting isocyanate of the diisocyanate adds onto the polyhydric alcohol. In a second step, the remaining free hydroxyl groups are reacted with a symmetrical diisocyanate to form the final prepolymer. The Examiner is directed to Column 2, Lines 11-27. Here *Bauriedel* presents the basic scheme of the '709 patent. In the first step of the reaction the prepolymer is formed "having a substantial number of free OH moieties attached through the alcohol nucleus". In the second step the remaining free hydroxyl moieties are reacted in an equimolar quantity or in a slight excess of isocyanate. Thus, the first step in *Bauriedel* is designed to produce a first stage product having a large number of free hydroxyl groups. This is unlike the present invention where it is required that the first stage product have only a single isocyanate reactive group after the addition of the first diisocyanate or polyisocyanate. That is why in the present invention the isocyanate is used in great excess relative to the number of isocyanate reactive groups. *Bauriedel* discloses in Column 2, Lines 11-15 that generally there is a great excess of OH Groups to NCO groups in the first step. Even at an OH:NCO ratio of 0.55, because the first diisocyanate is asymmetrical, you always have more active OH groups than NCO groups. If one were to take the disclosure of *Bauriedel* and replace the diisocyanate disclosed in *Bauriedel* with a polyisocyanate as claimed in the present invention one would create a product having extremely high cross-linking and gelatinizing behavior which would lead to a high viscosity and poor solubility product. This is why all the examples in the disclosure of *Bauriedel* are directed toward use of diisocyanates.

By way of contrast, the present invention allows for high-functionality polyisocyanates that

preferably have a functionality of six or greater. One of ordinary skill in the art would not, after reading the disclosure of *Bauriedel*, be motivated, taught, or given a suggestion to modify the disclosure to include the use of polyisocyanates and a ratio of polyisocyanate to isocyanate reactive compounds to produce a reaction product (A) having a single group that is reactive toward isocyanates and at least two free isocyanate groups.

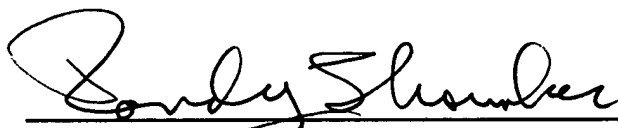
In summary, rejection of Claim 1, and the claims which depend therefrom, under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious in view of *Bauriedel* is improper and should be withdrawn.

Applicants' attorney respectfully submits that the claims as amended are now in condition for allowance and respectfully requests such allowance.

Respectfully submitted,

HOWARD & HOWARD ATTORNEYS

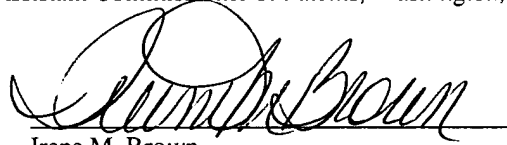
January 21, 2003
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MARKED-UP VERSION

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P21

1. (Amended) A process for preparing high-functionality polyisocyanates, which comprises

(i) preparation of an addition product (A) which contains one group which is reactive toward isocyanate and at least two isocyanate groups by reacting

(a) a diisocyanate or polyisocyanate I with

(b1) compounds having at least three groups which are reactive toward isocyanate or

(b2) compounds containing two groups which are reactive toward isocyanate or mixtures of (b1) and (b2),

where at least one of the components (a) or (b) has functional groups having differing reactivities toward the functional groups of the other component and the reaction ratio is selected so that the addition product (A) contains an average of one group which is reactive toward isocyanate.

(ii) if desired optionally, intermolecular addition reaction of the addition product (A) to form a polyaddition product (P) containing an average of one group which is reactive toward isocyanate and an average of more than two isocyanate groups, and

(iii) reaction of the addition product (A) and/or the polyaddition product (P) with a diisocyanate or polyisocyanate II.

a1

Sub
B2/A

(Amended) A process as claimed in claim 1 or 2, wherein the diisocyanate or polyisocyanate I has isocyanate groups of differing reactivity and comprises is selected from among tolylene 2,4-diisocyanate, tolyene 2,6-diisocyanate, diphenylmethane 2,4'-diisocyanate, phenylene 1,3- and 1,4-diisocyanate, naphthylene 1,5-diisocyanate, tolidine diisocyanate, triisocyanatotoluene, biphenyl diisocyanate, isophorone diisocyanate, 2-butyl-2-ethylpentamethylene diisocyanate, 2-isocyanatopropylcyclohexyl isocyanate, 3 (4)-isocyanatomethyl-1-methylcyclohexyl isocyanate, 1,4-diisocyanato-4-methylpentane, 4-methylcyclohexane 1,3-diisocyanate, dicyclohexylmethane 2,4'-diisocyanate and mixtures thereof.

ad
cont

5. (Amended) A process as claimed in claim 1 any of claims 1 to 4, wherein the diisocyanate or polyisocyanate II comprises is selected from among tolylene 2,4-diisocyanate, tolylene 2,6-diisocyanate, diphenylmethane 4,4'-diisocyanate, diphenylmethane 2,4'-diisocyanate, higher homologues of diphenylmethane diisocyanate, naphthylene 1,5-diisocyanate, tolidine diisocyanate, phenylene 1,3- and 1,4-diisocyanate, triisocyanatotoluene, biphenyl diisocyanate, tetramethylene diisocyanate, hexamethylene diisocyanate, dodecyl diisocyanate, lysine alkyl ester diisocyanate, where alkyl is C₁- C₁₀-alkyl, isophorone diisocyanate, 2-methylpentamethylene diisocyanate, 2,2,4- or 2,4,4-trimethylhexamethylene 1,6-diisocyanate, 1,3- and 1,4-diisocyanatocyclohexane, 3(4)-isocyanatomethyl-1-methyl-1-isocyanatocyclohexane, 2-butyl-2-ethylpentamethylene diisocyanate, 4-isocyanatomethyloctamethylene 1,8-diisocyanate, 2-isocyanatopropylcyclohexyl isocyanate, 2- or 4-methylcyclohexane 1,3-diisocyanate, dicyclohexylmethane 4,4'- and 2,4'-diisocyanate,

1,3- or 1,4-bis(isocyanatomethyl) cyclohexane, xylylene diisocyanate, tetramethylxylylene diisocyanate and oligoisocyanates or polyisocyanates prepared from the isocyanates listed by coupling by means of urethane, allophanate, urea, biuret, uretdione, amide, isocyanurate, carbodiimide, uretonimine, oxadiazinetriene or iminooxadiazinedione structures, or from among mixtures of the isocyanates mentioned.

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6. (Amended) A process as claimed in claim 1 any of claims 1 to 5, wherein, in the reaction of the addition product (A) and/or the polyaddition product (P) with the diisocyanate or polyisocyanate II, the ratio of isocyanate groups of the diisocyanate or polyisocyanate II to the isocyanate-reactive groups of the addition product (A) and/or the polyaddition product (P) is selected so that at least 10%, preferably at least 40%, of the NCO groups of the diisocyanate or polyisocyanate II are reacted.

7. (Amended) A process as claimed in claim 1 any of claims 1 to 6, wherein the isocyanate-reactive groups of the components (b1) and/or (b2) are selected from among hydroxyl groups, mercapto groups, amino groups and mixtures thereof.

8. (Amended) A process as claimed in claim 1 any of claims 1 to 7, wherein the diisocyanate or polyisocyanate I used is isophorone diisocyanate, isophorone diisocyanate trimer, tolylene 2,4-diisocyanate or diphenylmethane 2,4'-diisocyanate and the diisocyanate or polyisocyanate II used is hexamethylene diisocyanate, a hexamethylene diisocyanate oligomer mixture, diphenylmethane 4,4'-diisocyanate, diphenylmethane 2,4'-diisocyanate, a mixture of

diphenylmethane diisocyanates and higher homologues of diphenylmethane diisocyanate (polymeric MDI) or a mixture of the isocyanates listed.

9. (Amended) A process as claimed in claim 1 any of claims 1 to 8, wherein the compounds (b1) having groups which are reactive toward isocyanate are glycerol, trimethylolmethane, trimethylolethane, trimethylolpropane, 1,2,4-butanetriol, tris(hydroxymethyl) aminomethane, tris(hydroxyethyl) aminomethane, 2-amino-1, 3-propanediol, 2-amino-2-methyl-1, 3-propanediol, diethanolamine, dipropanolamine, diisopropanolamine, ethanolpropanolamine, bis(aminoethyl) amine, bis(aminopropyl) amine, trisaminononane, pentaerythritol, bis(trimethylolpropane), trifunctional or tetrafunctional polyetherols or polyesterols and the compounds (b2) used are ethylene glycol, diethylene glycol, triethylene glycol, tripropylene glycol, neopentyl glycol, 1,2- 1,3- and 1,4-butanediol, 1,2-, 1,3- and 1,5-pentanediol, hexanediol, propane-1, 2-dithiol, butane-1, 2-dithiol, mercaptoethanol, mercaptopropanol, mercaptobutanol, ethylenediamine, tolylenediamine, isophoronediamine, cysteamine, ethanolamine, N-methylethanolamine, propanolamine, isopropanolamine, 2-(butylamino) ethanol, 2-(cyclohexylamino) ethanol, 2-amino-1-butanol, 2-(2'-aminoethoxy) ethanol or higher alkoxylation products of ammonia, 4-hydroxypiperidine, 1-hydroxyethylpiperazine, aminopropanethiol or bifunctional polyetherols or polyesterols.

10. (Amended) A high-functionality polyisocyanate, which can be prepared as claimed in claim 1 any of claims 1 to 9.

11. (Amended) A high-functionality polyisocyanate which can be prepared as claimed in claim 1 any of claims 1 to 9 and has both aliphatically bound and aromatically bound isocyanate groups.

12. (Amended) The use of a polyisocyanate as claimed in claim 10 or 11 for producing paints and varnishes, coatings, adhesives, sealants, pourable elastomers and/or foams.

13. (Amended) A polyaddition product obtainable using a high-functionality polyisocyanate as claimed in claim 10 or 11.